



Nonnative Invasive Species

A National Problem with Southern Implications

July 2000



USDA Forest Service
Southern Region
Forest Health Protection

Effect, Scope, and Risk Posed by Nonnative Invasive Species

Sometimes known as biopollutants, nonnative invasive species of plants, pathogens, insects, and animals are affecting watershed integrity and sustainability, biological diversity, economics, human health, and safety in the United States.

As many as 50,000 nonnative species are estimated to have been introduced into the United States. At least 4,500 species are established. Approximately 675 species (15 percent) cause severe economic or environmental harm.

Almost every region of the nation is affected by at least one highly damaging nonnative invasive species. Other nations are experiencing this problem as well. In Canada, the approximately 900 nonnative plant species are about 28 percent of the plant species in the country.

Of 370 identified nonnative invasive species of insects in the United States, 17 are highly invasive to forests and have caused or could cause serious environmental and economic impacts.

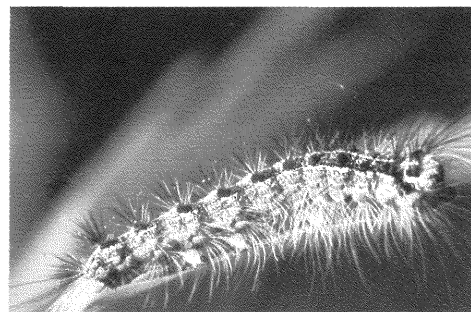
On National Forest System rangelands, 6 to 7 million acres are infested with noxious weeds and invasive plants. Infestations are increasing at an estimated expansion rate of 8 to 14 percent per year. Overall, on western public rangelands, 17 million acres are affected with noxious weeds. In some western range states, loss of land value is 60 to 80 percent. The weeds have more than quadrupled their range from 1985 through 1995. At this rate of spread it is conservatively estimated that western lands are being colonized at a rate of 4,600 acres per day by invasive plants such as leafy spurge and yellow starthistle.

In the East, the extent of the problem with nonnative plants is only now beginning to be documented. Eastern states are heavily forested. Forest invaders in the form of nonnative insects and pathogens present a long list of problems for landowners and land managers.

Environmental effects of harmful nonnative invasive species range from wholesale ecosystem changes to more subtle ecological changes and reduced biodiversity.

In their natural or native communities, species evolve ways to effectively compete for resources such as food. This results in a fairly stable community. Nonnative species alter or destabilize the interactions among organisms, creating a less varied and less productive community.

Once in a new environment, a nonnative invasive organism may simply die; it may become established with little noticeable effect; or it may become established and spread, often with devastating environmental and economic results. Populations of many nonnative invasive species expand rapidly upon reaching new habitats where the competitors, predators, pathogens and parasites that formerly kept them in check are no longer present. Without natural enemies to limit reproduction and spread, some nonnative species grow, adapt, multiply, and spread to unmanageable levels over time.



Gypsy moth caterpillars defoliate and weaken trees, which may lead to tree mortality.

Cover photo: Fraser fir killed by **balsam woolly adelgid** dominates the vista at Richland Balsam, NC.

Nonnative Invasive Species

A National Problem with Southern Implications

In their new environment, established nonnative species become harmful by destabilizing the existing ecosystem. Deforestation or conversion of tree species or both may occur, especially in urban settings. Riparian (streamside) forests may be altered, causing deterioration of water quality and wildlife habitat. Fire danger may increase. Habitats of indigenous species may be modified and degraded. Nonnative invasive species are the second largest cause of decline in 42 percent of the threatened and endangered species listed today. Only habitat destruction is a greater cause of loss or decline of native species.

As is discussed later, human health and safety, aquaculture, wild fisheries, cropland, livestock grazing lands, natural areas, utilities, and even building structures are affected by nonnative invasive species.

Cost Estimates

Although we know a lot about nonnative invasive species, the information is widely scattered and variable in quality and reliability. No single entity tracks new nonnative invasive species that enter or become established in the United States unless they are potential pests of agriculture, forestry, or human health, and even information about these pests is not comprehensive. As a result, current information about nonnative invasive species probably underestimates the magnitude of the problem, its costs, and its effects.

- David Pimental, Cornell University, estimates the cost and losses due to nonnative invasive species at more than \$125 billion per year.
- The U.S. Congress Office of Technology Assessment reported in 1993 that just 15 potential high-impact nonnative invasive species could cause \$134 billion in economic losses, a figure that excludes intangible impacts such as wildlife habitat effects.
- The Office of Technology Assessment also reported that from 1906-1991, just 12 percent of the harmful nonnative species caused losses of \$97 billion.

Among nonnative forest pests, the European gypsy moth has caused the greatest measurable losses and expenditures for research, survey, control, and eradication. The highest annual figure for estimated loss was \$764 million in 1981. In 1990, despite a \$20 million suppression program, the European gypsy moth defoliated an estimated 7.4 million acres. Cost estimates do not include the value of trees that were weakened and later died as result of gypsy moth damage.

The Asian gypsy moth necessitated a \$20 million expenditure for eradication in Washington and Oregon from 1992 through 1994 and an additional \$7 million more for projects in North Carolina in the mid-1990's. Eradication costs to eliminate the Asian longhorned beetle in New York and Chicago are expected to reach \$25 million by the end of the year 2000.

In the New York City area, about 4,500 trees (primarily maples) have been felled and chipped to eliminate the Asian longhorned beetle that was discovered there in 1996. In Chicago about 1,400 trees have been removed and destroyed since 1998. At press time, the count of trees removed continues to increase in both cities. A new, more diverse urban forest is being replanted.

Introduction of Beneficial Nonnative Species

Many nonnative plants and animals are beneficial and some have become significant in American agriculture and commerce.

Nonnative Invasive Species

A National Problem with Southern Implications

- Almost all economically important agricultural commodities (including crops and livestock) are of foreign origin.
- Weeping willow, ginkgo, iris, and Bermuda grass are familiar nonnative trees and plants.
- The European honeybee pollinates many field and orchard crops.
- Nonnative fish and shellfish, such as some oysters, are common; so are sportfish (the brown trout) and game birds (the chukar partridge and the ring-necked pheasant).
- Most pet and aquarium industries are based on domesticated and other nonnative species, including cats, dogs, hamsters, goldfish, tropical fish, snakes, turtles, and chameleons.

Intentional introductions may be for horticultural use, ecological improvement such as erosion control, biological pest control, commercial use (such as for the aquarium trade), hunting and game use, and research purposes. Sometimes nonnative species are intentionally introduced in controlled situations, but then escape confinement and become invasive. In the East, invasive ornamental trees include the princess tree (*Paulownia tomentosa*), the Norway maple (*Acer platanoides*), and the tree-of-heaven (*Ailanthus altissima*). Many plant species that are classified by some states as noxious invaders are still available for purchase in other states.

Unintentional introductions of harmful insects and plant pathogens have been far more common than have been intentional introductions. Among terrestrial vertebrates, fish, and mollusks, intentional introductions have caused harm about as often as have unintentional ones.

Introduction and Spread of Nonnative Species

The unintentional introduction of nonnative invasive species into the United States is a by-product of travel, immigration, and global commerce. Once introduced, the domestic spread of invasive species occurs naturally, and often with (intentional or unintentional) human assistance.

There are many pathways through which nonnative invasive species enter the United States and spread. Ports, urban centers, areas of frequent commerce away from ports, and other human population centers tend to be important sites for this type of introduction.



Kudzu, introduced as a beneficial plant to cover boulders and later used to control erosion, has become a serious nonnative invasive species that can grow over and then replace anything currently in a forest edge or opening.

- They may enter unintentionally in timber, produce, seeds, or nursery stock.
- They may exist on or in the wood used for packing crates or dunnage, which is how the Asian gypsy moth and the Formosan termite were introduced.
- They may be transported in freight; by railway cars, tractors, aircraft, automobiles, bicycles, ships, and other vehicles; in ballast water dumped from ships; on hiking boots, camping equipment, lawn furniture; and in or on soil.

State and Federal plant quarantine laws slowed the rate of introduction of insect pests and plant pathogens after 1912. Rates rarely reach zero and have been higher throughout the 20th century than in the preceding one.

Nonnative Invasive Species

A National Problem with Southern Implications

Many years may pass before a nonnative species is detected; during this time it acclimates to its new habitat and may reproduce and spread, which makes it more difficult for regulatory agencies to detect, eliminate, or control it. Research suggests that establishment rates for nonnative species are probably low.

Addressing and Controlling the Problem

There are no easy solutions for the control of most nonnative invasive species. Prevention and control measures include port inspection, quarantine, eradication, and containment. Suppression (using physical, chemical, or biological controls) and ecological restoration are important tools for managing the problem. Each has associated costs and limitations.

Federal agencies manage approximately 30 percent of the nation's lands. The complexity of jurisdictions on the remainder of lands in state and private ownership makes managing the nonnative invasive species more difficult.

On February 3, 1999, President Clinton signed an Executive Order (#13112) to strengthen the national response to this threat by preventing introductions, minimizing damaging effects of invasive species, monitoring invasive species populations, conducting research, and restoring ecosystems and habitats among other actions. To improve domestic planning and coordination, and international cooperation, an Invasive Species Council was established. The council is cochaired by the Secretaries of Interior, Agriculture, and Commerce and includes the Secretaries of State, Treasury, and Defense.

Nonnative Invasive Species -- Selected Examples

Insects and Pathogens

American forests have been heavily impacted by nonnative insects and pathogens. The composition of rural and urban forests has changed as a result. Elm, chestnut, butternut, oak, fir, hemlock, and maple are but a few of the types of trees that have been affected.

In the early 1900's, the **chestnut blight**, brought in on diseased horticultural stock from China, all but eliminated the entire population of American chestnuts. American chestnut had been the most economically important hardwood species in eastern forests. It was significant in the urban forest and was an important food source for forest dwelling animals and birds. Chestnut forests converted primarily to oak. The oaks that replaced the chestnut are less well adapted to their sites, and thus are more susceptible to environmental stresses such as drought. In some areas this oak population is also a preferred host for the gypsy moth.

European gypsy moth populations rise and fall. Defoliation caused by feeding caterpillars weakens trees and can lead to mortality. Cooperatively funded Federal and state programs, which use chemical and biological insecticidal treatments and monitoring, reduce defoliation. In some locations, the gypsy moth has been attacked by a fungus. However, neither the fungus nor treatment programs eliminates the insect. A cooperative program (called Slow-the-Spread) is underway in some states. This program reduces the rate of spread of the gypsy moth, delaying the onset of damage and the need for costly suppression projects.



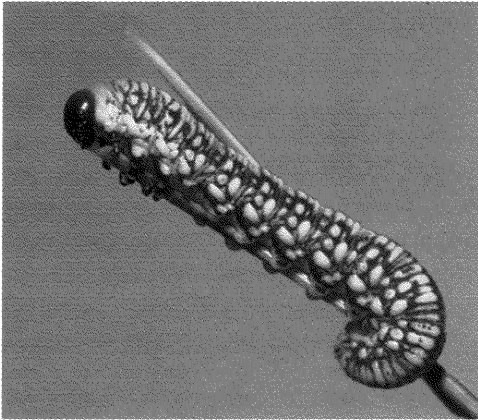
Hemlock woolly adelgid is an example of a successful nonnative invasive species accidentally introduced on ornamental plants.

Nonnative Invasive Species

A National Problem with Southern Implications

The **brown-tail moth** and the **satin moth**, which are also defoliating insects, were introduced into the United States in 1920. They initially caused extensive defoliation and tree mortality, then populations declined, and are now found only occasionally.

The **introduced pine sawfly** periodically defoliates white pine plantings in North Carolina and Virginia. Since many of these plantings are in Christmas tree farms, loss can be significant. Introduced and natural enemies are playing an important role in limiting the damage caused by this nonnative pest.



Introduced pine sawfly larva feeding on pine needle.

Dutch elm disease devastated vast numbers of shade trees in Western Europe in the 1920's and 1930s. In 1930 it was discovered in the United States along with its vector, the European bark beetle. Since its discovery in the United States, an estimated 46 million elms have died. Many communities were left barren of shade trees. A Dutch elm disease control and prevention project is underway in the District of Columbia. Elms resistant to the disease are now available.

Butternut canker is another devastating nonnative disease. Butternut wood is valued for furniture and carving, and has a place in American folk art. In 1995, the USDA Forest Service estimated that 77 percent of butternut in Virginia and North Carolina had died from this disease.

Surviving butternut is heavily infected and not reproducing. Researchers and foresters are attempting to cultivate disease resistant trees.

Dogwoods, are highly valued for their beauty during the spring. The first reports of **dogwood anthracnose**, a disease caused by a nonnative fungus, are from 1978. Since then dogwood anthracnose has spread through the high elevation (above 3,000 feet) part of the dogwood range in 7 southern states, virtually eliminating dogwood from that upper elevation forest.

Infestations of the **hemlock woolly adelgid**, which kills hemlocks, occur in two states in the South and are spreading. A nonnative, predacious ladybug is being evaluated as a natural enemy of this adelgid. Fraser fir in the southern Appalachians has been hard hit by the **balsam woolly adelgid**, having major negative impacts on the entire fir ecosystem.

White pine blister rust has reduced the value of both eastern and the western white pine, important components of numerous ecosystems in the U.S. and Canada. While affecting the eastern white pine resource in both Virginia and North Carolina, this nonnative fungus appears to be limited to the higher elevations in these two states by the range of the alternate host (*Ribes* spp.).

Plants and Animals

Kudzu, a perennial vine first introduced for ornamental use and later planted throughout the South for erosion control, is widespread in the Southeast, and infests as much as 7 million acres nationally. It can grow as much as a foot per day, blanketing everything in its path and invading timberlands, farmlands, and yards. It kills trees in forest edges and openings by entirely covering them and shading them to death. It can take 3 to 5 years of active management to control established infestations. Lost farm and timber production are estimated at \$50 million yearly.

Nonnative Invasive Species

A National Problem with Southern Implications

Japanese honeysuckle, another introduced vine, has become a serious pest of forest margins, rights of way, and other open spaces. It forms both ground-covering mats and dense infestations of tree-climbing vines. **Japanese climbing ferns** (two nonnative species) create problems throughout the southern Coastal Plain. While their occurrence is scattered, they often form dense mats along highways and other rights-of-way from which they spread and overwhelm native vegetation. **Oriental bittersweet** has infested much of the cooler parts of the Southeast, primarily forestland in the Appalachian Mountains. As with the other three vines, it grows over and replaces native vegetation in areas where infestation occurs.

Purple loosestrife, a flowering plant introduced during the 1800's, is found in all 48 of the contiguous states. It chokes wetlands, replacing shoreline native vegetation. **Cogongrass**, an aggressive, colony-forming grass introduced in Florida, has become a major disrupter of native plant populations in rights-of-way, young forest plantations, and other openings such as fields and pastures. This nonnative invader is not killed by fire and is seldom killed by a single application of pesticides, making it a particularly difficult pest to control.

Several nonnative shrubs have become major disrupters of ecosystems in the Southeast, invading sites and replacing native vegetation. They include **Chinese** and **Japanese privets**, **climbing Euonymus**, **tropical soda apple**, and **multiflora rose**. Aggressive growth, lack of natural parasites, and the dense shade they cause under their leaves have led each of these to become successful in the South, to the detriment of native plant populations.

Several species of **Lespedeza** have become significant pests in forests and forest openings due to their dense leafy growth form which shades out all competition. These nonnative shrubs are still being planted in some areas either as wildlife food or as soil rehabilitating (nitrogen fixing) plants. Seeds from these plants are spread by birds and new plants thrive under moderate to dense overstory cover which makes them extremely difficult to exclude.

Two species of nonnative insects, the **black** and the **red fire ant**, have been introduced into the United States. The red fire ant is more widespread and presents the greatest problem. It infests 275 million acres in 11 southern states and Puerto Rico. It stings humans, and has caused serious injury and death of hypersensitive individuals. It kills poultry chicks, lizards, snakes and ground nesting birds. Damage and control measures cost approximately \$500 million per year in Texas alone.



Chinese privet, often used to as a hedge plant, has become a major pest in the forest environment.

The **Formosan termite**, the **pink hibiscus mealybug**, and the **Asian longhorned beetle** currently pose real threats to both urban and forest resources in the South. While the mealybug primarily attacks ornamental plantings of *Hibiscus* species (also nonnative plants), the other two insects attack a broad range of living hosts and wood products. While climate may ultimately limit the ranges of these three invaders, there are no biological barriers known at present to prevent their explosive spread in the South.

Nonnative Invasive Species

A National Problem with Southern Implications

Information in this fact sheet is from the USDA Forest Service and the following sources:

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